Instructions for Building A Moving Platform for A Robot

Attaching the Caster Wheels

1. A caster wheel should be placed near the bottom center of the platform. That is near the center of the platform but on the opposite side from the holes that are already drilled in the platform.
2. Place the caster wheel where it should go and with a pencil mark where the holes for the screws are.
3. Ask one of the adults who has a drill to drill holes where you have marked.
4. Use a screwdriver to attach the caster wheel to the platform by putting a screw through the base of the caster wheel and into the holes in the platform.
5. For the rest of the time you are building of the robot you can leave the caster wheel hanging over the edge of your table.

Attaching the Drills

6. Attach the drills to the board. One drill should be on each side of the board (that is one on the left and one on the right). The chuck of each drill hangs over the edge of the board, and the handle points toward the center of the board. See the illustration.
7. Each drill should be secured in place with two hose clamps. To do this you must:
   - Unscrew the hose clamp.
   - Thread it through the holes already cut in the board and around the drill as shown in the illustration.
   - Reconnect the free end of the hose clamp.
   - Use a nut driver to tighten down the hose clamp. Be sure to position the hose clamp such that as you tighten it you do not run out of room. That is, you don't want the nut to run into the board before the hose clamp is tight.

Putting the Axles on the Power Wheels

8. Put a small piece of rubber tubing on one end of the axle.
9. Put the end of the axle with the rubber on it in the wheel. This will be difficult to do, because the axle needs to be tight so it will turn with the wheel.

Crating the Holder for the Drill Batteries - The drill batteries go on the outside of each drill handle.

10. Place the battery where it will go (see the illustration) and draw a pencil line along the edge of the battery.
11. Hammer two nails into the platform just out side the pencil line. This will give you a place to put the battery where it will not slide when the platform moves.

Connecting the Speed Controllers and the Receiver

12. The wires coming from the speed controllers with the red and black connectors need to be connected to the drills.
    - On the left motor they probably will need to be connected red to red and black to black.
    - On the right motor they probably will need to be connected red to black and black to red.[*]
    - If you get this wrong you can fix it in the testing phase.
13. The wires with the white connectors that are coming from the speed controllers need to be connected to the batteries. Connect them red to red and black to black.
14. The three small wires coming from each speed controller that are all connected to a flat black connector need to be connected to the receiver.
15. The wires connected to the receiver should be connected with the black wire on the outer side of the receiver.
    - The speed controller for the left motor should be connected to channel 3.
    - The speed controller for the right motor should be connected to channel 2.
16. Attach a piece of Velcro to the platform where each speed controller is going to be placed.
17. Attach a piece of Velcro to the platform where the receiver is going to be placed.
18. Attach the speed controllers and the receiver to the Velcro you just put on the platform.
19. Attach a piece of Velcro to the platform an inch or two from the receiver. This will later be used to secure the receiver's battery to the platform.

Attaching the Power Wheels

20. The axle form one of the power wheels should be placed in the chuck of each drill.
21. The drill chucks should be tightened.

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[*] Since the drills are facing opposite directions, the drill on the right hand side will need to spin the opposite direction to the drill on the left hand side for them to push the car in the same direction (think about it).

Connecting the Receiver's Battery and Putting the Crystal in the Receiver

22. To run your robotic platform, you will need to connect a battery to your receiver and put a crystal in it. You will also need a transmitter.
23. Since we only have two transmitters, the groups will have to take turns using them. Each transmitter has its own frequency so you will need to put a crystal in the receiver that matches the frequency of the transmitter you are using.
24. You also need to but a battery in the receiver. It is connected to the slot marked B. **Be sure the black wire is on the outer side of the receiver**.
25. Don't leave the crystal in the receiver when you are not using the transmitter. If someone else is using the transmitter they may cause your motors to turn when you are not expecting it. This could break your fingers if they were in the wrong place when this happened!!

Testing

26. The joystick on the left should control the left wheel of the robotic platform and the joystick on the right should control the right wheel.
27. Some speed controllers have a power switch, you may need to turn it on.
28. You may need to use the black sliding controls on the transmitter to center the joysticks. This means to make them so the motors do not move when the joysticks are in the center positions.
29. If one of the motors turns the opposite way form what you want, you can change this by reversing the connections on the wires that connect the speed controller to the motor. Be sure to turn off the transmitter and disconnect the battery from the speed controller before changing the connections.

The Basics of How the Robotic Platform Works

- The robotic platform moves when the power wheels are turned by the drill motors. The drill motors turn when a voltage is applied to them. The more voltage the faster they turn, if the voltage is reversed they turn in the opposite direction.
- The speed controllers take the voltage from the batteries and feed it to the motors but they control how much voltage and what its polarity is.
- The speed controllers each get a signal from the receiver telling it how much voltage to send to its motor.
- The receiver gets a signal from the transmitter with the information about how much voltage the speed controllers should send to the motors.
- The transmitter sends the information in the form of radio waves. Each transmitter has a particular frequency it uses. By slightly varying its frequency information is encoded in the radio waves.
- Certain crystals vibrate when they are exposed to radio waves of a particular frequency. Which frequency causes a crystal to vibrate depends on the particular crystal.
- Our receivers have a place to insert a crystal so that we can change the crystal to one that will vibrate at the frequency our transmitter is using. This way we can use the same receiver with different transmitters. We just have to change the crystal.
- This also allows us to control two robots at once. We just need to use two transmitters each using a different frequency. We put a crystal matching one of the transmitters in one robot and a crystal matching the other transmitter in the other robot. Each transmitter will now control its robot, but be ignored by the other robot.
- Most transmitters have more then one channel. This allows them to control several motors at once. Each channel is connected to a different control on the transmitter.
- On our transmitters channel 3 is controlled by the forward and back motion of the left joystick and channel 2 is controlled by the forward and back motion of the right joystick. This is why we used channel 3 to control the left wheel and channel 2 to control the right wheel.
- Channel 1 is controlled by the left to right motion of the right joystick. This gives us another option for controlling our robotic platform. We can move the wire connected to the left motor's speed controller from channel 3 to channel 1. This will mean we only have to use one joystick to control our robot. Left to right motion of the joystick will move the left wheel. Forward and back motion of the joystick will move the right wheel. By moving the joystick to other positions we can move both wheels at once. We can steer by moving the joystick to different positions and varying the relative speed of the two wheels.

Drawing of Robotic Platform (Not to Scale)